C. Remarks

This amendment is responsive to the office action dated May 16, 2007. In the office action, claims 1-14 were rejected under 35 U.S.C. 102/103 as being unpatentable over Armand and/or Chiang. A request for a two month extension of time for response is also included herewith. For the reasons set forth below it is submitted that the claims, as amended, are clearly patentable over the art of record. If any fees are required by this amendment, including the extension of time fee, please charge Deposit Account No. 502874.

Regarding the 35 USC 112 Rejections, the claims have been amended to correct the matters of language/punctuation and antecedent basis noted in the office action. Claims 15-25 have been cancelled as non-elected in response to the restriction requirement and new claims 26-27 have been added to define the size of the particles and the iron dextran component.

The Invention

Claim 1 has been amended to more particularly define the invention over the prior art and simplify the issues presented by this application. In the amendment to claim 1 the term "iron dextran nanoparticles coated with a anti agglomeration molecule in a liquid solution" has been replaced with "dispersing iron dextran nanoparticles in a liquid solution". Also subparagraph f has been replaced with subparagraphs f and g to

better explain the process steps and to correct an inversion in the values of X.

Claim 1 as amended reads as follows:

A method of producing olivine type nanostructured lithium metal phosphate of the formula, $LiFe_xM_{1-x}PO_4$, where $1 \leq x \leq 0.1$ and M is a metal cation and having an olivine structure, comprising the following steps:

(a) dispersing iron dextran nanoparticles in a liquid solution,

(b) at least one of the steps of :1) dissolving a metal salt in the liquid solution and 2) dispersing metal oxide nanoparticles in the liquid solution,

(c) dissolving a phosphate ion containing chemical precursor in the liquid solution,

(d) dissolving a lithium containing salt in the liquid solution,

(e) heating the solution to promote the precipitation of $LiFe_xM_{1-x}PO_4$ precursor material, and

(f) evaporating the liquid and calcining the ~~solids~~ $LiFe_xM_{1-x}PO_4$ precursor material for removing volatiles, and

(g) annealing the $LiFe_xM_{1-x}PO_4$ precursor material to form the olivine type nanostructured $LiFe_xM_{1-x}PO_4$ compound.

The prior art

The present invention teaches a method for producing nanostructured $LiFe_xM_{1-x}PO_4$ material where $0.1 \leq x \leq 1$ and M is a metal cation. The present invention teaches the production of nanostructured olivine type $LiFe_xM_{1-x}PO_4$ materials using nanoparticles of a unique iron-precursor, iron-dextran powder. The premise of adding nanoparticles of iron-dextran in an aqueous solution, along with the precursors of lithium, phosphate and metal

cation (M) is that iron-dextran nanoparticles, which form a stable dispersion in water, will act as the *nucleation sites* to form nanophase $LiFe_xM_{1-x}PO_4$ precursor material, which on annealing forms nanostructured $LiFe_xM_{1-x}PO_4$ which is very suitable for use as a cathode material with an olivine structure. Nanophase $LiFe_xM_{1-x}PO_4$ precursor material precipitates out from an aqueous solution. The solution is prepared by dissolving lithium and phosphate salts, by dispersing iron-dextran nanoparticles and either by dissolving a metal salt or dispersing metal oxide nanoparticles in water. This aqueous solution is heated at a temperature $\leq 100\,^{\circ}C$ to promote the precipitation of nanopahase $LiFe_xM_{1-x}PO_4$ material, which is subsequently calcined and then annealed at an elevated temperature (> 400 °C) in an inert atmosphere to produce nanostructured $LiFe_xM_{1-x}PO_4$ material.

On the other hand, both Armand et al. (US 2004/0086445) and Chiang et al., adopted synthesis methods that are similar to a conventional solid-state method for producing a ceramic material wherein precursor materials only control the final composition, *but not the size of primary particles or crystallites* as taught in the present invention. In both cases, iron, phosphate and lithium precursors were mixed. Armand et al. also included sugar, such as glucose and cellulose, as a source of carbon. However, in their case, sugar is not added to avoid the agglomeration of precursor material because the mixture was heated to a temperature high enough to decompose sugar molecules to produce carbon. Additionally, the starting raw materials were not nanoscale powders, and it was not taught or described that the size of raw materials will have a bearing on the size of the final product. Chiang et al. did not use a co-precipitation method. In their process,

raw materials of different constituents were mixed by a ball mill in acetone. The solvent was evaporated to produce the dry mixture. Additionally, Chiang et al. did not make use of nanoparticles of precursor materials to produce nanostructured $LiFePO_4$ or $LiFe_xM_{1-x}PO_4$ materials.

However, the present patent application teaches a process for producing composite $LiFe_xM_{1-x}PO_4$ powder using a unique iron-carbon precursor: iron-dextran. The iron-dextran compound (avg. particle size: 20-30 nm) is composed of iron hydroxide nanoparticles that are chemically bounded with a dextran molecule with a typical molecular weight of 3000-5000. The iron-dextran compound supplies iron and is believed to provide nucleation sites to form pure phase $LiFe_xM_{1-x}PO_4$ material. The nucleation sites provide a pre-configured nano sized precursor to assist in the growth of the final phase pure $LiFe_xM_{1-x}PO_4$ particles.

The use of a iron-dextran pre-configured nano sized precursor as et forth in the claims as amended is not similar, nor obvious from, to previously disclosed or described methods, including Armand et al.'s patent application and Chiang. However, to produce $LiFe_xM_{1-x}PO_4$ cathode materials with good electrochemical properties, in addition to composition, the particle (or crystallite) size of the material also need to be controlled. The present invention teaches the control of the particle (or crystallite) size by using the iron-dextran precursor (average particle size 20-30 nm), which has a specific core size (~ 3 nm) and a unique microstructure [see US patent 5,624,668].

It is respectfully submitted that the claims that the prior art, when taken alone or in combination, does not teach the production of a nanostructured $LiFe_xM_{1-x}PO_4$ material through the use of a iron-dextran pre-configured nano sized precursor. Thus, the claims as amended are clearly patentable over the art of record, and notice to that effect is earnestly solicited. If the Examiner has any questions regarding this matter, the Examiner is requested to telephone applicants' attorney at the numbers listed below prior to issuing a further action.

Respectfully Submitted,

Dated: October 16, 2007

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